Dr George Little!

FOR THE PARIS EXPOSITION.

CATALOGUE

OF

ORES, ROCKS AND WOODS,

SELECTED FROM THE

Geological Survey Collection

OF THE

STATE OF GEORGIA, U. S. A.

WITH A DESCRIPTION OF THE GEOLOGICAL FORMATIONS.

GEORGE LITTLE, PH. D.,
STATE GEOLOGIST.

ATLANTA, GA.:
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CATALOGUE.

The Geological Formations of Georgia embrace:

1. QUATERNARY, of the		Atlantic Coast
		Okefenokee Swamp.
		Drift Deposits.
2. TERTIARY, Eocene of the		Vicksburg group.
	"	Jackson group.
	"	Claiborne group.
3. SECONDARY, Cretaceous Nos. 5, 4 and 1 of		Upper Missouri section.
4. PALEOZOIC, of the Carboniferous Period		Coal-measures.
	"	Millstone grit.
	"	Sub-carb. limestone.
	Devonian	Black Shale—Genesee.
	"	Oriskany.
	Upper Silurian	Niagara.
	"	Clinton.
	"	Medina.
	Lower Silurian	Cincinnati.
	"	Trenton.
	"	Chazy.
	"	Quebec.
	"	Potsdam.

5. METAMORPHIC.—No fossils. Stratigraphic equivalents of Lower Silurian. Subdivisions not all distinguished.

ROCKS AND MATERIAL, REPRESENTING FORMATIONS.

QUATERNARY AGE.

White and yellow sands, with drift (water-worn pebbles); white and variegated clays; argillaceous sandstones (white clay and sand conglomerate); coarse white micaceous sands; yellowish sands, with ferruginous sandstones, ferr. concretions and concretionary iron ore.

TERTIARY PERIOD.

Red and yellow loam, with concretionary iron ore—brown hematite; limestone; buhrstone; greenish white clays, with loose silicified shells; greensand (glauconite); white joint clays, with lignitic seams and ledges of claystone; white clay marls; silicious fossiliferous sandstone; interstratified sands and shaly clay; white sandy marl; compact clayey limestone (indurate marl); blue fossiliferous joint-clay; blue and gray shell marls, with lignite; compact white and yellow limestones; white

friable coral limestone; white joint clay; hard and compact white limestone (in some cases arenaceous).

CRETACEOUS PERIOD.

Limestone, highly fossiliferous; blue shell-marl, alternating with nodular limestone strata; blue micaceous glauconitic clay; yellow fossiliferous clay; blue micaceous clay, with few fossils; white clays and sands.

CARBONIFEROUS AGE.

Coal-measures.—Sandstones, shales, ironstones, fireclays, and three to five beds of coal. 500 feet.

Millstone grit.—Conglomerates, sandstones, shales, ironstones, and one bed of coal. 400 feet.

Upper Sub-carboniferous.—Massive limestones, partly oölitic, mostly pure, less lime to the eastward, few shaly beds. 500 feet.

Lower Sub-carboniferous.—Silicious group of Safford; limestone, more or less impure, mostly filled with silicious concretions; at some points shales, partly bituminous and thin-bedded argillaceous limestones. 200 feet.

DEVONIAN AGE.

Genesee Epoch.—Black shale, bituminous; pyritous sandstone at base. 100 feet.

UPPER SILURIAN AGE.

Oriskany Epoch.—Very silicious limestone, weathering to a skeleton on the outcrop. 4 feet

Clinton Epoch.—Shales, few thin limestones and argillaceous sandstones, and one to three beds of fossiliferous hematite. 400 feet.

Medina Epoch.—Ferruginous sandstones, few shales. 400 feet.

LOWER SILURIAN AGE.

Cincinnati Epoch.—Thin-bedded, ferruginous, silicious limestones and shales; hematites, rarely of workable thickness. 200 to 400 feet.

Trenton Epoch.—Thin-bedded limestones and shales, changing eastward to ferruginous shales. 700 feet.

Chazy Epoch.—Limestone, mostly shaly, becoming more ferruginous and argillaceous to the eastward. 600 feet.

Quebec Epoch.—Upper part—Cherty magnesian limestone, generally heavy-bedded, with one or two layers of white saccharoidal sandstone near middle of limestone. 400 feet. Lower part—Shales, often calcareous, with few generally thin-bedded limestones, partly oölitic. 2,000 feet.

Calciferous Epoch.—Shales, often glauconitic, thin-bedded sandstones, rarely glauconitic, and silicious argillaceous limestones. 2,000 feet.

Potsdam Epoch.—Hard, ferruginous sandstones, generally quartzytic, partly thick-bedded, partly thin and argillaceous. 2,000 (?) feet.

Acadian Epoch—Upper part—Everywhere partly metamorphosed slates, with conglomerate layers; passing into schists and gneisses. 10,000 (?) feet. Lower part—Hydromica schists. 2,000 feet.

METAMORPHIC.

Apparently all are stratigraphical equivalents of the Lower Silurian; but the subdivisions are not all distinguished. No fossils found.

Cincinnati Group.—Gneisses, largely hornblendic, sometimes quartzytic. Few hydromica schists. Often includes epidosytes (?) [see No. 190]. Some copper, little gold. Probably includes the flexible sandstones of the upper part of the "Itacolumyte Series" of Lieber. 15,000 (?) feet thick.

Quebec Group.--At top, limestones and dolomytes, with chert more or less altered into tremolite, accompanied by heavy beds of chrysolite, serpentine, chlorite and steatyte, often with abundant crystals and masses of corundum, chromite, spinel, etc. Some gold, galenite and traces of silver. The lower part of the group consists largely of hydromica schists, with thick and thin beds of gneiss, hornblende schists, quartzytes and partly solidified sandstones. Includes the lower part of Lieber's "Itacolumyte Series." Gold indigenous, abundant; less copper; much garnet, cyanite, rutile, ilmenite, magnetite, pyrite; a few diamonds. 12,000 (?) feet thick.

Upper Potsdam Group (Calciferous not separately recognized)—Heavy-bedded gneiss, with few schists; little hornblende. Thin steatytes, with serpentine and asbestus, at top. Little or no gold, often pyritous. 2,000 (?) feet thick.

Lower Potsdam, or Acadian.—Mica and hydromica schists; little hornblende. Bands of gneiss, often conglomeratic. Some gold, workable copper; much pyrite; some roofing slate. 13,000 (?) feet thick.

LIST OF SPECIMENS EXHIBITED.

ORES AND PRODUCTS.

1. Lead Ore—Galenite............................Lincoln county.
2. Manganese Ore—Pyrolusite.....................Lincoln ..
3. Copper Ore—Chalcopyrite, etc.................Paulding ..
4. Copper Ore...................................Paulding ..
5. Sulphur Ore— Pyrite..........................Fulton ..
6. Sulphur Ore—Pyrite ....Paulding ..
7. Sulphur Ore—Pyrite ....Haralson ..
8. Chrome Ore...................................Troup ..
9. Iron Ore—Hematite............................Carroll ..
10. Iron Ore—Hematite ....Bartow ..
11. Iron Ore—Limonite...........................Gordon ..
12. Iron Ore—Limonite........................... Bartow ..
13. Iron........................Rome Iron Co., Floyd ..
14. Steel Rail ....Atlanta Rolling Mill, Fulton ..
15. Spiegel Iron ....Pool's Furnace, Bartow ..
16. Iron........................Atlanta Rolling Mill, Fulton ..
17. Ferro-manganese................Ward's Furnace, Bartow ..
18. Manganese Ore—Pyrolusite ....Bartow ..

18a. Manganese Ore...............................Bartow ..

19. Asbestus....................................Fulton ..

19a. Asbestus...................................Rabun ..

20. Heavy Spar—Barite...........................Bartow ..
21. Corundum....................................Carroll ..
22. Corundum in Serpentine......................Towns ..

22A. Gold Ore...................................Lumpkin ..

22B. Gold Ore...................................Lumpkin ..

22C. Gold Ore ....Lumpkin ..

22D. Gold Ore...................................Lumpkin ..

22E. Gold Ore ....White ..

22F. Gold Ore...................................Paulding ..

BUILDING STONES, ETC.

23. Sandstone...................................Bartow ..
24. Limestone...................................Bartow ..

24a. Lime (made from No. 24)....................Bartow ..

25. White Limestone.............................Polk ..
26. Marble......................................Haralson ..
27. Marble......................................Whitfield ..
28. Marble, fossiliferous. ....Walker ..
29. Black Marble................................Polk ..
30. Black Marble................................Whitfield ..
31. White Marble (3 specimens)..................Pickens ..
32. Variegated Marble ....Pickens ..
33. Fire Brick ....Baldwin ..

GEOLOGICAL SERIES.

Name.	Formation.	Group.	County.
42. Opal	Tertiary	Jackson	Washington.
44. Agate	Tertiary	Jackson	Washington.
45. Buhrstone	Tertiary		Calhoun.
46. Sandstone, fossiliferous	Tertiary	Jackson	Jefferson.
47. Sandstone, fossiliferous	Tertiary	Jackson	Wilkinson.
48. Silicified Wood	Quaternary		Clay.
49. Sandstone, ferruginous	Quaternary		Houston.
50. Sandstone, fossiliferous	Tertiary	Jackson	Jefferson.
51. Sandstone, ferr. argillaceous	Quaternary		Dodge.
52. Sandstone, fossiliferous	Tertiary	Jackson	Glascock.
53. Iron Ore	Tertiary		Stewart.
54. Clay, white	Tertiary	Jackson	Washington.
55. Limestone	Tertiary	Claiborne	Clay.
56. Limestone	Tertiary	Passage beds—Jackson and Claiborne	Houston.
57. Marl, yellow	Tertiary	Jackson	Burke.
58. Marl, white	Tertiary		Screven.
59. Marl, yellow	Tertiary	Claiborne	Clay.
60. Greensand marl	Tertiary	Jackson	Houston.
61. Calcite	Tertiary	Jackson	Twiggs.
62. Limestone	Tertiary	Vicksburg	Mitchell.
63. Flint, ferruginous	Tertiary		Pulaski.
64 Buhrstone	Tertiary		Burke
65. Limestone	Tertiary	Vicksburg(?)	Pulaski.
66. Gypsum	Cretaceous		Stewart.
67. Shell marl, blue	Cretaceous		Clay.
68. Coal	Carboniferous		Dade
68a. Coal	Carboniferous		Walker.
69. Sandstone	Carboniferous		Dade.
70. Sandstone	Carboniferous		Dade.
71. Conglomerate	Carboniferous		Walker.
72. Concretion	Sub-carboniferous		Walker.
73. Concretion	Sub-carboniferous		Floyd.
74. Concretion	Sub-carboniferous		Catoosa.
75. Limestone, chert partly dec'd	Sub-carboniferous		Walker.
76. Limestone	Sub-carboniferous		Gordon.
77. Chert, oolitic	Sub-carboniferous		Walker.
78. Chert	Sub-carboniferous		Walker.
79. Shale, blue, with concretions	Devonian	Genesee	Catoosa.
80. Shale, black	Devonian	Genesee	Walker.
81. Chert	Upper Silurian	Oriskany	Catoosa.
82. Hematite, fossiliferous	Upper Silurian	Clinton	Dade.
83. Hematite, fossiliferous	Upper Silurian	Clinton	Dade.
84. Hematite, fossiliferous	Upper Silurian	Clinton	Dade.
85. Hematite, fossiliferous	Upper Silurian	Clinton	Chattooga.
86. Hematite, fossiliferous	Upper Silurian	Clinton	Walker.
87. Sandstone, argillaceous	Upper Silurian	Clinton	Dade.
88. Sandstone, ferruginous	Upper Silurian	Medina	Whitfield.
89 Conglomerate, fine	Upper Silurian	Medina	Whitfield.
90. Sandstone, ferruginous	Lower Silurian	Cincinnati	Whitfield.
91. Sandstone	Lower Silurian	Cincinnati	Whitfield.
92. Limestone	Lower Silurian	Cincinnati	Whitfield.
93. Sandstone, ferruginous	Lower Silurian	Cincinnati	Walker.
94. Limestone	Lower Silurian	Trenton	Chattooga.
95. Limestone	Lower Silurian	Trenton	Walker.
96. Concretion, silicious	Lower Silurian	Chazy	Walker.
97. Sandstone, polishing	Lower Silurian	Upper Quebec	Whitfield.
98. Sandstone, saccharoidal	Lower Silurian	Upper Quebec	Whitfield.
99. Breccia	Lower Silurian	Upper Quebec	Catoosa.
100. Chert	Lower Silurian	Upper Quebec	Catoosa.
101. Chert, cellular	Lower Silurian	Upper Quebec	Walker.
102. Chert, concretion	Lower Silurian	Upper Quebec	Walker.
103. Chert, oolitic	Lower Silurian	Upper Quebec	Gordon.
104. Chert, with quartz veins	Lower Silurian	Upper Quebec	Gordon.
105. Chert	Lower Silurian	Upper Quebec	Walker.
106. Limestone, cherty	Lower Silurian	Upper Quebec	Walker.
107. Limestone, variegated	Lower Silurian	Upper Quebec	Whitfield.
108. Limestone	Lower Silurian	Upper Quebec	Whitfield.
109. Limestone, red variegated	Lower Silurian	Upper Quebec	Walker.
110. Limestone, dolomitic	Lower Silurian	Upper Quebec	Catoosa.
111. Limestone, oolitic	Lower Silurian	Lower Quebec	Catoosa.

GEOLOGICAL SERIES.—*Continued.*

Name.	Formation.	Group.	County.
112. Shale, glauconitic	Lower Silurian	Lower Quebec	Whitfield.
113. Limestone, with galenite	Lower Silurian	Calciferous	Catoosa.
114. Schist, chloritic	Lower Silurian	Calciferous	Catoosa.
115. Limestone, silicious	Lower Silurian	Calciferous	Chattooga.
116. Quartzyte	Lower Silurian	Potsdam	Bartow.
117. Quartzyte	Lower Silurian	Potsdam	Bartow.
118. Gneiss	Lower Silurian	Acadian	Murray.
119. Gneiss, porphyritic	Lower Silurian	Acadian	Bartow.
120. Conglomerate	Lower Silurian	Acadian	Bartow.
121. Conglomerate	Lower Silurian	Acadian	Bartow.
122. Conglomerate	Lower Silurian	Acadian	Gilmer.

METAMORPHIC ROCKS.

123. Flint	Lower Silurian	Quebec	Lincoln.
124. Quartzyte	Lower Silurian	Cincinnati	Towns.
125. Quartzyte	Lower Silurian	Cincinnati	Hall.
126. Quartzyte, pyritous			Harris.
127. Quartzyte, pyritous	Lower Silurian	Quebec	White.
128. Schist, silicious, auriferous	Lower Silurian	Quebec	White.
129. Schist, silicious, auriferous	Lower Silurian	Quebec	White.
130. Quartzyte, schistose, auriferous	Lower Silurian	Quebec	White.
131. Itacolumyte	Lower Silurian	Cincinnati (?)	Hall.
132. Itacolumyte	Lower Silurian	Cincinnati (?)	Hall.
133. Itacolumyte	Lower Silurian	Quebec (?)	Heard.
134. Gneiss, quartzytic, garnetiferous	Lower Silurian	Cincinnati (?)	Talbot.
135. Quartzyte, cellular	Lower Silurian	Quebec	Hall.
136. Quartzyte, gneissoid	Lower Silurian	Potsdam	Heard.
137. Quartzyte, gneissoid	Lower Silurian	Potsdam	Muscogee.
138. Granyte, pink	Lower Silurian		Muscogee.
139. Feldspar	Lower Silurian	Cincinnati	Habersham.
140. Kaolin	Lower Silurian	Cincinnati (?)	Union.
141. Kaolin	Lower Silurian	Cincinnati (?)	Fulton.
142. Quartzyte, conglomeratic	Lower Silurian	Cincinnati	Gilmer.
143. Quartzyte, conglomeratic	Lower Silurian	Acadian	Bartow.
144 Conglomerate, granytoid	Lower Silurian	Acadian	Bartow.
145. Gneiss, quartzytic	Lower Silurian	Cincinnati	Lumpkin.
146. Granite	Lower Silurian	Cincinnati (?)	DeKalb.
147. Gneiss	Lower Silurian	Cincinnati	Fannin.
148. Gneiss, banded	Lower Silurian	Quebec	Fulton.
149. Gneiss	Lower Silurian	Cincinnati	Habersham.
150. Gneiss, biotitic, porphyrytic	Lower Silurian	Acadian (?)	Harris.
151. Gneiss, biotitic	Lower Silurian	Cincinnati (?)	Campbell.
152. Gneiss, porphyrytic	Lower Silurian	Cincinnati (?)	Habersham.
153. Gneiss, biotitic, porphyrytic	Lower Silurian	Quebec	Lumpkin.
154. Schist silicious, ferruginous, decayed	Lower Silurian	Quebec	White.
155. Mica schist	Lower Silurian	Quebec	Hart.
156. Hydromica schist	Lower Silurian	Cincinnati (?)	Towns.
157. Hydromica schist, decayed	Lower Silurian	Calciferous (?)	Gilmer.
158. Mica schist	Lower Silurian	Cincinnati	Habersham.
159. Argillyte, decayed	Lower Silurian	Quebec	Gilmer.
160. Argillyte, silicious	Lower Silurian	Cincinnati	Gilmer.
161. Hydromica schist porphyrytic	Lower Silurian	Cincinnati	Gilmer.
162 Hydromica schist, garnetiferous	Lower Silurian	Calciferous	Gilmer.
163. Hydromica schist, garnetiferous	Lower Silurian	Quebec	Lumpkin.
164. Hydromica schist, garnetiferous	Lower Silurian	Quebec	Lumpkin.
165. Chlorite schist, graphitic	Lower Silurian	Cincinnati	Gilmer.
166. Chlorite schist	Lower Silurian	Quebec	Habersham.
167 Chlorite schist	Lower Silurian	Quebec	Habersham.
168. Chlorite schist	Lower Silurian	Quebec	Douglas.
169. Steatyte	Lower Silurian	Quebec	DeKalb.
170. Steatyte	Lower Silurian	Quebec	Rabun.
171. Talcose schist, silicious	Lower Silurian	Quebec	Taylor.
172. Hornblende slate, talcoid	Lower Silurian	Quebec	Lumpkin.

METAMORPHIC ROCKS.—*Continued.*

Name.	Formation	Group.	County.
173. Hornblende schist	Lower Silurian....	Quebec	Lumpkin.
174. Hornblende schist, decayed.	Lower Silurian....	Quebec..	Lumpkin.
175. Hornblende schist, decayed.	Lower Silurian....	Quebec	White.
176. Hornblende schist, pyritous.	Lower Silurian....	Quebec	Towns.
177. Hornblende schist, pyritous.	Lower Silurian....	Quebec	Towns.
178. Hornblendic gneiss	Lower Silurian....	Cincinnati	Towns.
179. Hornblendic gneiss	Lower Silurian....	Cincinnati	Rabun.
180. Hornblendic gneiss, decayed	Lower Silurian....	Cincinnati (?)	Towns.
181. Syenitic gneiss	Lower Silurian....	Cincinnati	Lumpkin.
182. Mica schist, calcareous	Lower Silurian..	Cincinnati	Gilmer.
183. Limestone, shaly, pyritous..	Lower Silurian....	Cincinnati	Gilmer.
184. Limestone, micaceous	Lower Silurian....	Cincinnati	Gilmer.
185. Chert	Lower Silurian....	Quebec	Hall.
186. Tremolyte, calcareous, (altered chert)	Lower Silurian....	Quebec	Hall.
187. Quartzyte, cyanitic	Lower Silurian ..	Quebec	Lumpkin.
188. Quartzyte, chrysolitic	Lower Silurian....	Quebec	Dawson.
189. Dunyte	Lower Silurian....	Quebec	White.
190. ? Epidosyte ?	Lower Silurian....	Cincinnati	Towns
191. Trap	Jurassic (?)		Coweta.
192. Trap	Jurassic (?)		Habersham.
193. Trap	Jurassic (?)		DeKalb.
194. Trap	Jurassic (?)		DeKalb.
195. Trap, decayed.	Jurassic (?)		Franklin.
196. Trap, decayed	Jurassic (?)		Gwinnett.
197. Trap	Jurassic (?)		Lincoln.

WOODS.

198. Magnolia glauca—Sweet Bay...............Okefenokee swamp.
199. Liriodendron tulipifera—Poplar.................Murray county.
200. Æsculus pavia—Buckeye ....Whitfield ··
201. Acer saccharinum—Sugar Maple.............Whitfield ··
202. Acer dasycarpum—Silver Maple................Murray ··
203. Prunus serotina—Wild Cherry...... ....Murray ··
204. Prunus spinosa—Sloe..........................Walker ··
205. Liquidambar styraciflua—Sweet Gum...........Murray ··
206. Nyssa multiflora—Sour Gum. ....Murray ··
207. Ilex opaca—Holly.............................Murray ··
208. Dyospyros Virginiana—Persimmon..............Murray ··
209. Persea Carolinensis—Red Bay...............Okefenokee swamp.
210. Sassafras officinalis—Sassafras ....Murray county.
211. Ulmus Americana—Elm.........................Murray ··
212. Ulmus fulva—Slippery Elm.....................Murray ··
213. Ulmus alata—Wahoo ....Murray ··
214. Celtis occidentalis—Hack-berry.................Walker ··
215. Platanus occidentalis—Sycamore..............Whitfield ··
216. Carya tomentosa—Hickory....................Whitfield ··
217. Carya alba—Shell-bark Hickory...............Whitfield ··
218. Juglans nigra—Black Walnut...................Murray ··
219. Castanea Americana—Chestnut......... ......Whitfield ··
220. Fagus ferruginea—Beech. ....Murray ··
221. Ostrya Virginica—Hop Hornbean...............Murray ··
222. Salix nigra—Black Willow...................Whitfield ··
223. Pinus glabra—Spruce Pine.....................Murray ··
224. Pinus rigida—Pitch Pine.......................Murray ··
225. Juniperus Virginiana—Red Cedar...............Walker ··
226. Taxodium distichum—Cypress ....Okefenokee swamp.
227. Sabal palmetto—Cabbage Palmetto...............Glynn county.

GEOLOGICAL DESCRIPTION.

The general strikes of the Georgia outcrops being approximately northeast and southwest, a section from northwest to southeast shows most readily the general structure.

The extreme northwest corner of the State includes a small area of the Coal-measures, nearly level and undisturbed, forming, practically, an outlier of the great plateau of the Cumberland Mountains. But a small part of the series exposed in these mountains appears here, and this probably belongs to the Millstone grit. Starting southeastward, we almost immediately encounter, along the edges of the plateau outliers, upturned portions of the same beds, in which the first signs of metamorphism appear, in the partially de-bitumenized coals.

The Subcarboniferous beds have mostly very limited outcrops, as mere borders of the small Coal-measure areas, except along one line of outliers from which the Coal-measures have been entirely removed, and only Subcarboniferous occupies the surface.

The upper limestones are mostly quite pure, and yield fossils in some abundance. They seem to represent the Chester and St. Louis divisions of the formation. The lower limestones are very impure, containing large amounts of cherty concretions, with comparatively few fossils. The shales at the base of the series are partly bituminous, partly silicious, and contain, at bottom, the band of phosphatic nodules which mark the horizon through Tennessee, Kentucky and Southern Indiana.

The Devonian black shale, of the Genesee epoch, varies from ten to eighty feet, or more, in thickness, and is of no economical importance. Few fossils have been found, either in the shale itself, or in the pyritous, shaly sandstone at its base, whose age is still in doubt, since it may be properly part of the shale group, or it may represent some other portion of the Hamilton group, just as a pyritous fish-bearing shale represents the Tully limestone of New York, in the western counties of that State.

Of the Oriskany, but a few inches have been identified by fossils, and that only at a single locality. This shows a lenticular mass of quartzose sandstone, from which the calcareous fossils have been weathered out, along the outcrop.

The Clinton group presents several distinct lines of outcrop, of a thick series of variously colored, mostly ferruginous, calcareous shales, with a few thin beds of limestone and argillaceous sandstone, which are sometimes crowded with fossils. In its western outcrops, it includes three distinct beds of oölitic hematite, more or less calcareous, all frequently of workable thickness; but to the eastward these are reduced to a single layer, and that finally but a few inches thick. The sandy layers increase in this direction.

The thick ferruginous sandstone of the Medina outcrops along ridge lines, making marked features of the landscape. Passing the last of

these, we finally leave behind us all the newer Paleozoic rocks, and enter a region of exclusively Lower Silurian strata, stretching to the southern and eastern edges of the metamorphic area. These lower beds have also appeared in the several anticlinal valleys already crossed, but mostly not in so full development as where we now find them.

The Cincinnati group consists mainly of thin bedded limestones, which are pretty pure to the westward, but become increasingly silicious and ferruginous, and thickens somewhat as we pass eastward. In a few localities, they are quite shaly. At many points, there are small deposits of fossiliferous oölitic hematite, rarely. however, in sufficient amount to be workable. In the more easterly outcrops, these ores are frequently more or less metamorphosed into "specular" ore, sometimes distinctly crystallized. The ferruginous, silicious limestones have also there suffered incipient metamorphism—the structure lines being much distorted, the lime carbonate partially crystallized, and the whole mass solidified to almost a quartzytic texture, while the fossils are still distinct, and the iron is still mechanically, rather than chemically, combined.

The Trenton group is represented by a thin series of limestones, pure to the westward, becoming argillaceous and ferruginous, and finally shales, to the eastward. The shales are hardly to be distinguished from those above and below, within the non-metamorphic area, and become utterly undistinguishable in their metamorphic condition.

The Chazy limestones are more or less shaly through their entire outcrop; but the impurities of the western portion become the main constituent of the layers in their eastern extension.

The Quebec group dolomites are heavy-bedded, and of enormous thickness—commonly reaching a total of from 3,000 to 4,000 feet. With the exception of occasional layers, they are very impure throughout their entire outcrop, being commonly argillaceous and silicious, and often inclosing nodules and masses of chert in immense quantity. They very rarely yield fossils. Neither in degree of impurity nor in thickness, do they vary much, in passing from one part of the area to another. The shales of the lower part of the group are generally calcareous, and include a few thin beds of fossiliferous limestone. They vary but little in composition, but are partially altered into slates in their eastern portions.

Of the area thus far described, the western portion rises into sharp ridges, reaching elevations of from 1,200 to 2,300 feet above the sea, with intervening valleys at levels of from 700 to 1,000 feet. The eastern portion, occupying the flatter half of the continuation of the "Great Valley" of East Tennessee and Virginia, has an average elevation of about 1,000 feet for the ridges, and perhaps 800 for the valleys. It may be noted here, that the higher ridges are all synclinals, while the anticlinals are marked by the lowest valleys. In leaving this non-metamorphic area, bounded by the Cohutta mountains on the east, and

by the Dugdown mountain on the south, we rise sharply, except along the gap occupied by the Western and Atlantic Railroad, from 300 to about 3,000 feet above the level of the adjoining portions of the "Great Valley." The actual limit of the area we are leaving, is a line of faults, on the northwestern side of which only a slight degree of metamorphism is found; while, on the opposite side, nearly everything is much altered. The first rocks encountered are commonly the semi-metamorphic slates, assigned, with little doubt, to the Acadian, and provisionally termed the "Ocoee" by Safford.

They occupy long but generally narrow areas. Immediately above them, we commonly find the heavy-bedded ferruginous sandstones of the Potsdam (Chilhowee of Safford,) not seen within the non-metamorphic area, which is mostly quartzytic along the Cohutta range, but is represented further eastward and southward by gneisses of all grades of crystallization. Along only one line of outcrop do we find any evidence of rocks underlying and older than the Acadian. This single exception is the area of soft hydromica schists, with quartz veins, which includes the copper region running south from the southeast corner of Tennessee. As these strata show no signs of unconformability, we are obliged to account them part of the Acadian group.

In these outer portions of the metamorphic area, the alteration of the beds is but partial, the shales being baked into argillytes, more or less glassy; the sandstones solidified into quartzytes, with the sand grains and pebbles still distinct; the limestones crystallized, but with their impurities only partially combined. But as we pass southeastward, the change becomes more complete, the shales becoming mica, hydromica, chlorite and talc schists; the chert masses of the Quebec group are crystallized into tremolyte; the magnesian shales and limestones become steatytes, serpentines and chrysolytes (dunyte); the sandstones become quartzytes and gneisses, often losing all lamination, and appearing as granites; the quartz veins, which are at first few in number, become numerous, and are partially replaced by veins of granite. These latter are at first small, but are finally very large, and even appear to be the sole occupants of extensives areas. Here again the synclinals commonly form the mountains and higher ridges, while the lines of anticlinals are commonly marked by valleys.

The entire mass of the metamorphic rocks, so far as yet definitely determined, is of Lower Silurian age. Much the larger part of the area has been identified, beyond a question, with the Potsdam, Quebec and Cincinnati groups, leaving only very limited patches within which it is still possible that small islands of Archean rocks may be recognized. As already stated, the Trenton, Chazy and Calciferous beds vary so slightly from the Quebec and Potsdam strata that they can be distinguished with difficulty, even when not metamorphosed; and not at all when altered, at least with the amount of study which it has yet been possible to bestow upon them. We are, therefore, compelled to neglect them as being but subordinate fractions of the larger groups. The Quebec

group, already 6,000 feet thick in the non-metamorphic area, now presents a possible maximum of from 12,000 to 15,000 feet, and forms much the larger portion of the metamorphic area. It is also, economically, the most important portion, because it is the matrix of nearly all the gold of Georgia. It also includes workable deposits of copper ore, and large amounts of corundum. A few diamonds have been found upon its outcrops. The Cincinnati group occupies, generally, narrow areas, and yields but little mineral wealth, including small amounts of gold, copper and iron. The Potsdam outcrops are of still smaller extent, and yield almost nothing except building stone. The Acadian sub-group yields roofing slate and copper ores.

Crossing the metamorphic rocks, generally along lines approximately transverse to the strike, there are several dykes of various forms of trap. Their formation evidently occurred after the upturning and metamorphism of the enclosing strata, which disturbance is referred to the Permian; and they are probably of the same age as the Jurassic (?) dykes which accompany the Triassic red sandstones of North Carolina and more northern States.

CRETACEOUS.

This formation has but a small representation in Georgia. Its beds are exposed in a narrow belt extending from Columbus southward, nearly to Fort Gaines, and consist of blue micaceous marls and greensand clays, yellow fossiliferous with white plastic clays.

An abundance of fossils, both vertebrate and invertebrate, exist in the blue and yellow marls, and the beds are highly pyritiferous, with limestone nodules and gypsum. The country is usually broken from denudation, and the hills capped with sand and ferruginous sandstone.

The marls contain about ten per cent. of lime, with potash and phosphoric acid, averaging, each, about .5 per cent. The greensand clays have about six per cent. of pure greensand, the thickness of the bed being from fifteen to twenty feet, and are exposed in the river bluffs.

TERTIARY.

The tertiary marls of the State are confined mainly to a belt of country, averaging about forty miles in width, and lying immediately south of a line drawn across the State from Fort Gaines, through Macon and Milledgeville, to Augusta.

The lowest and thickest bed is a white friable marl, containing, at some localities, as high as ninety per cent. of carbonate of lime. In the other beds, the proportion of carbonate of lime varies from this to a mere trace. Along this Eocene outcrop, there are also deposits of almost pure "green sand," or glauconite, while we find this mineral, at various localities, present also in the calcareous marl, in almost every possible proportion. These marls have been used to considerable extent as fertilizers; and in almost every instance the result has been highly satisfactory. Where it has been otherwise, the fault has been either in the quantity used, or in the mode of application.

The buhrstone also extends entirely across the State, and overlies the calcareous beds. Some very fine mill-stones have been manufactured from this rock, in Burke and Jefferson counties.

In the Tertiary loams—as well as in the superficial quaternary deposits—there occurs a good quality of concretionary iron ore—brown hematite. This has been worked in some localities.

QUATERNARY.

This formation is found capping the hills and overlying the Tertiary beds mentioned above, and may be considered as co-extensive therewith. Its useful materials are—

1. CLAYS.—These are sedimentary in character, and vary from pure white porcelain-clay, to dark purplish pipe-clay. They are already being utilized, in the manufacture of crockery ware, pottery, fire-brick, etc.; and, from their excellent quality, their utilization is destined to become one of the leading industries of the State.

2. SANDSTONES, OR CLAY AND SAND CONGLOMERATES.—These are also sedimentary—the finer material above them having been longer held in suspension, and deposited more quietly. They are composed of white clay, and coarse sand or gravel. They harden on exposure, and make a first-class building material.

3. FERRUGINOUS SANDSTONES.—The ferruginous sandstones are very abundant, and of good quality. They are easily quarried, and make a most excellent building stone.

TIMBER.

Nearly all that portion of the State lying south of the line drawn above, as the northern boundary of the Tertiary, is timbered with long-leaf *yellow pine*. This section embraces about thirty thousand square miles. Supposing twenty per cent. of this to be cleared, (which is an over-estimate,) we have twenty-four thousand square miles of pine timber, which will produce, on an average, 30,000 feet of first-class *heart* lumber *per acre*.

WATER POWERS OF GEORGIA.

The principal water powers of Georgia are found north of a line passing through Columbus, Macon and Augusta. The waters of the branches, creeks and small rivers of this elevated region are accumulated several hundred feet above the ocean level, and precipitated from the tough metamorphic rocks upon the lower Tertiary country below, thus forming some of our most gigantic water powers, at an elevation entirely free from malaria, and immediately surrounded by the cotton growing regions of Carolina, Georgia and Alabama.

The estimates given below are for the theoretical horse-power of the stream, without the accumulation of its waters in a reservoir. The horse-power is equivalent to 33,000 foot-pounds.

Chattahoochee river, Columbus	35,552 horse-power.
Chattahoochee river, Fulton county	2,448 horse-power.
Ocmulgee river, Lloyd's shoals	3,970 horse-power.
Ocmulgee river, Seven Islands	2,040 horse-power.
Ocmulgee river, Capps Shoals	508 horse-power.
Ocmulgee river, Glover's mill	1,368 horse-power.
Etowah river, Bartow county	2,250 horse-power.
Etowah river, Franklin mines	1,029 horse-power.
Etowah river, Lumpkin county	272 horse-power.
Holt's Shoal's Bibb county	1,050 horse-power.
South River, Butts county	350 horse-power.
South River, Clark's Factory	247 horse-power.
Snake creek, Carroll county	405 horse-power.
Pataula creek, Clay county	601 horse-power.
Armuchee creek, Floyd county	151 horse-power.
Coosawattee, Carter's mill	3,085 horse-power.
Oconee river, Long Shoals Factory	1,824 horse-power.
Oconee river, Riley's shoals	2,054 horse-power.
Oconee river, Oconee county	5,642 horse-power.
Oconee river, Jackson county	271 horse-power.
Tallulah river, Habersham county	20,508 horse-power.
Mulberry creek, Harris county	1,020 horse-power.
Towaliga, High Falls	1,530 horse-power.
Yellow River, Cedar Shoals	1,302 horse-power.
Yellow River, Cedar and Henley shoals	2,000 horse-power.
Little River, Eatonton Factory	155 horse-power.
Nacoochee Gold Mining Co., White county	575 horse-power.
Savannah river, Augusta canal	12,000 horse-power.

These are only a few of the many which might be mentioned.